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The Air Force Agency for Modeling and Simulation: Advancing Modeling and Simulation for the Warfighter

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In the mid 1990s General Ronald Fogleman, then U.S. Air Force (USAF) Chief of Staff, was determined to correct the deficiencies in modeling and simulation (M&S) that were uncovered in the months and years following Desert Storm. The existing models, technology, and expertise did not accurately represent air and space power, particularly in Joint exercises, experiments, and studies. This was exacerbated in that the Combatant Commanders did not have accurate air and space power representations when formulating contingency plans, nor the ability to accurately rehearse those plans with the limited airpower simulations that would drive their exercises. Additionally, the Air Force was not yet exploiting the power of simulation to properly communicate to Congress and the Office of the Secretary of Defense on such issues as roles, missions, and funding. An M&S policy office was established but still had no governance structure. The Air Force had no top-level Air Force integrator or servicewide coordinating processes and integrating initiatives, and had many competing air models.

As a result, General Ronald Fogleman signed "A New Vector" in 1995 *(Figure 1)*, outlining the USAF's plan to improve its use of M&S. At a four-star Summit, the Chief of Staff of the Air Force (CSAF) and the Secretary of the Air Force (SAF) sponsored the creation of an Air Staff Field Operating Agency (FOA) in Orlando, Florida, to specifically meet these challenges, the Air Force Agency for Modeling and Simulation (AFAMS). Headquarters USAF Program Action Directive 96-4 officially implemented the CSAF's decision and AFAMS stood up on June 3, 1996.

Today, AFAMS, which is aligned under the Secretary of the Air Force, Office of Warfighting Integration and Chief Information Officer (SAF/XC), is commanded by Colonel James Dennis. Col Dennis leads a diverse organization that oversees M&S activities around the globe and maintains liaison officers at Nellis and Hurlburt Air Force bases. AFAMS is strategically located in Orlando, Florida, because of the synergy created by the presence of all of the Services: Army Program Executive Office—Simulation, Training, Instrumentation; Naval Air Warfare Center Training Systems Division; and Marine Corps Program Manager Training Systems. The Services' primary simulation and training acquisition and sustainment organizations comprises over 2500 people and $5 billion a year in business, and are colocated in the Central Florida Research Park adjacent to the nation's sixth largest university, the University of Central Florida.

AFAMS' mission is to ensure appropriate representation of air, space, and cyberspace in modeling and simulation; integrate and ensure interoperability of Air Force models and simulations; coordinate Air Force M&S support for Service, Joint, Inter-Agency and Coalition events, and develop and maintain appropriate M&S skills and knowledge for Air Force personnel. AFAMS provides oversight and is the Executive Agent for a suite of simulations known as the Air, Space, and Cyber Constructive Environment (ASCCE). These simulations are the authoritative representation of air, space, and cyber power for U.S. Title 10 training exercises and mission rehearsals conducted jointly in all major commands around the world *(Figure 2)*. The Electronic Systems Center at Hanscom Air Force Base (AFB) is the program office overseeing development of

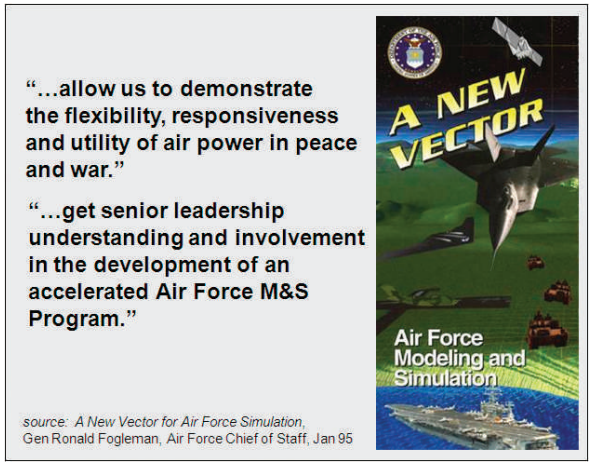

Figure 1. General Ronald Fogleman articulated his vision for M&S in 1995.

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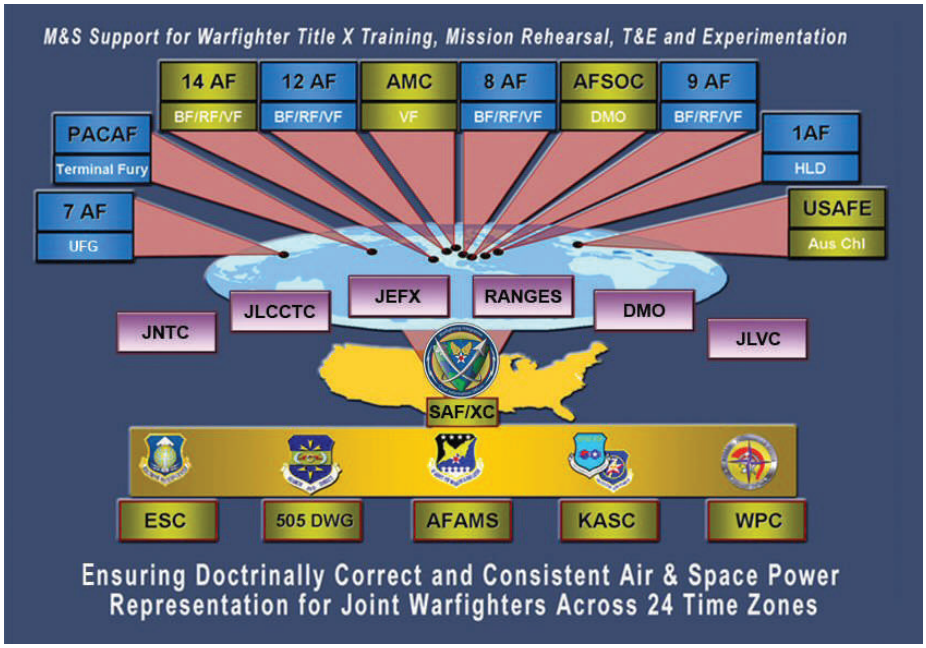

Figure 2. ASCCE is used throughout the USAF for warfighter events. It is the authoritative air, space, and cyber representation for certifying Joint Force Air Component Commanders and their staff.

the simulations. The 505th Distributed Warfare Group at Kirtland AFB, the Korean Air Simulation Center at Osan Air Base, the Warrior Preparation Center in Germany, and the 1st Air Force at Tyndall AFB are the organizations and major simulation centers conducting Title 10 training and other exercises where ASCCE is leveraged. AFAMS provides M&S expertise and the simulations for such venues as Pacific Command's Terminal Fury, European Command's Austere Challenge, and U.S. Forces Korea's Ulchi Freedom Guardian. ASCCE stimulates real world systems for Air Operations Centers and provides air power; intelligence, surveillance, and reconnaissance virtual imagery; and integration. ASCCE provides the ability to interface and stimulate operational command and control systems, broadcast systems, and can interface to virtual and live-fly systems to provide for integration in a Live, Virtual, and Constructive (LVC) environment.

AFAMS works with the Air Force, the other services, and Joint Forces Command on a broad range of activities where M&S is required to represent air and space power. AFAMS also provides oversight and subject matter expertise of the ASCCE for use in experimentation and demonstration events such as the Joint Expeditionary Force Experiment (JEFX) and the Coalition Warrior Interoperability Demonstration (CWID). JEFX is conducted by another FOA under SAF/XC, the Global Cyber Integration Center. JEFX consists of experiments with participation from sister services, coalition nations, combatant commands, and government agencies to assess initiatives to fulfill identified gaps in warfighting capability. CWID is the Chairman of the Joint Chiefs of Staff's annual event, enabling combatant commanders and our coalition partners to investigate command, control, communications, computers, intelligence, surveillance, and reconnaissance solutions for enhancing coalition interoperability. CWID investigates information technologies that have the potential to integrate into an operational environment within the near term following demonstration execution every year in June.

In the early 2000s, AFAMS, along with Air Combat Command and the Air Staff and several other organizations, led an initiative to increase the distributed simulation capabilities across the Air Force and achieve the CSAF's vision for Distributed Mission Operations (DMO). An Initial Requirements Document and a Concept of Operations were approved by the Air Force Requirements Oversight Council and the CSAF to promote the concept of using distributed virtual fighters, bombers, and intelligence-surveillance-reconnaissance platforms with constructive simulations supporting battlestaff (up to the Combined Air Operations Center) in a small team and larger total team environment. Bridging the tactical to operational levels of war, DMO has grown to include more players at more locations around the world. AFAMS leads the DMO Technical Management Working Group to address the overarching technical challenges and issues with bringing such a diverse group together for training events.

AFAMS continues to provide capabilities to the field in ever-expanding arenas. One such area has been developing the architecture to support the USAF Warfare Center's (USAFWC) training of the Air Support Operations Center Initial Qualification Course. Complementary to this, AFAMS is providing the architecture expertise and simulations for the Joint Terminal Attack Controller on the live ranges that the USAFWC integrates with during joint training events. AFAMS is working with Red Flag at Nellis, a multinational exercise providing a realistic environment to practice combat scenarios, to support the live fly with computer simulations in a variety of means (intelligence-surveillance-reconnaissance, command and control, threats). These and similar activities are part of a broad effort to integrate "live-fly" participants with participants in virtual simulators and constructive simulations representing computer generated forces (collectively termed LVC) into a seamless environment that can be used for training, testing, experimentation, analysis, and similar functions.

5-year plan for an LVC Constructive Integrating Architecture

The Army has established a Joint Requirements Oversight Council (JROC)–approved LVC Integrating Architecture (LVC-IA) program to help manage Army progress in using LVC capabilities for training. Building in part on the Army's success, an Air Force LVC-IA program is being initiated to establish a coordinated, programmatic approach to achieving persistent, integrated LVC capabilities.

The key precepts to accomplishing this objective are: (a) *Do no harm* (don't break what works). (b) *Interoperability is not free* (focused investment is required). (c) *Start with small, immediate steps* (work fifth generation training shortfalls and other critical challenges first). (d) *Provide centralized management* (provide a corporate Air Force perspective and cross-functional standards and solutions). The fundamental approach and focus of the LVC-IA is to establish an LVC Enterprise perspective to all LVC efforts, and forge commonality, consistency, and efficiency through an integrating architecture. The Air Force is developing an LVC-IA 5-Year Plan to guide the major commands and the acquisition product centers on a clear path to success.

The LVC-IA Program will have multiple areas of technical and nontechnical challenges to work on behalf of all user communities. The guidelines for the LVC-IA 5-Year Plan and for an initial implementation plan are in coordination across the Air Force in a draft document worked on throughout 2008. AFAMS hosted two government-only meetings in June and September 2008 and briefed the M&S General Officer Steering Group in November 2008 on the way ahead to achieving an LVC-IA.

Why a USAF Enterprise LVC-IA?

The Air Force has Integrated LVC simulation capabilities in select areas within the Air Force training community. Blue Flag exercises have used virtual environments to enhance their training objectives. Virtual Flag exercises have merged multiple virtual simulators with constructive simulations and select live systems for training and mission rehearsal. Red Flag has provided venues for large scale exercises such as Joint Red Flag to prove the value of LVC simulation primarily for training and mission rehearsal events. Unfortunately, an LVC environment must be created for each exercise, with its own tools, network services, and simulations, with no guarantee of persistent on-demand capabilities. These environments take months to plan, build, integrate, test, and then finally use for the event. They disappear after the exercise with little reuse the next time the event is staged. Senior leadership recognizes this, and at the April 2008 CORONA conference, it was noted that the DMO Program of Record is resource limited and not funded for such a broad LVC capability.

Additionally, the Air Force test and training ranges no longer have the capability to exercise to their full capability current or future weapons, systems, and aircraft. Live range space, availability, and technical capabilities are being outpaced by warfighter systems' technology. We cannot exploit the capabilities of the fifth generation F-22 or F-35 fighters, and we cannot produce adversary support sufficient to test and train fifth generation fighters. Range restrictions, won't allow for effective test and training of emerging munitions with extended range footprints. The feasibility and cost of procuring realistic double-digit surface-to-air missiles (SAMs) or limiting factors in our capability to retool existing range simulator assets highlight the challenges in training to known adversary capabilities. Reduction in the flying hour program means fewer sorties to generate the same number of aircrew needed to fill cockpits with fully mission-capable individuals. There are a number of databases and networks used by multiple players each unable to network with the other. We need architectures and standards that will fix this to provide fifth generation training. The creative integration of virtual and constructive capabilities into live test and training ranges is the only means to replicate full scale operational capabilities and support realistic training, testing, and other functional area support. In short, live range space, availability, and technical capabilities are

Figure 3. The LVC Integrating Architecture Enterprise Initiative will allow for more efficient federation composition and reuse in the LVC domains.

being outpaced by warfighter systems technology. This will only be exacerbated as the Air Force continues to develop technical and doctrinal capabilities to defeat emerging threats. This is a primary driver for the LVC-IA program.

A persistent LVC Enterprise will be based on enterprise standards and protocols and not just a single site's architecture, resulting in a consistent environment for development and testing *(Figure 3)*. This will help to ensure that systems acquisitions result in more inherent interoperability and simulator concurrency upon fielding. It will also help solve operational test limitations. For example, given physical range limitations, a live aircraft could fly a target engagement scenario with simulated weapons release, while a virtual-constructive environment could concurrently be used for modeling and evaluating weapon fly-out and end-game effects of the weapons.

AFAMS is working closely with the test and evaluation (T&E) community to ensure future enterprise capabilities are on track with the Office of the Secretary of Defense's *Testing in a Joint Environment Roadmap* as well as the Air Force Operational Test and Evaluation Center's (AFOTEC) *Test Capability Roadmap*. The LVC-IA will leverage the Joint Mission Environment Test Capability (JMETC), which was established in October 2006 to address the shortfalls in T&E with joint operational context. This will also serve to keep the Air Force aligned with the new Department of Defense Instruction 5000.02, "Operation of the Defense Acquisition System," dated December 2, 2008, which states in part:

> *"The PM, in concert with the user and the T&E community, shall coordinate DT&E, OT&E, LFT&E, family-of-systems interoperability testing, information assurance testing, and modeling and simulation (M&S) activities, into an efficient continuum, closely integrated with requirements definition and systems design and development." [DoDI 5000.02, December 2, 2008]*

Access to real-world architectures, weapon systems (including operational flight programs), and opposition force conditions during interoperability testing will be enhanced by leveraging the advances the training community makes along with the test communities' continued development of current and future systems.

While all functional communities are included within the 5-year plan, training will be the primary initial focus for LVC integration because of the urgent shortfall in training capabilities for fifth generation fighters and weapon systems, and ongoing global war on terror operational needs. Because of the interrelationship of testing and training, commensurate needs of the testing community will necessarily be addressed, with a parallel focus on working the breadth of test integration issues. The training and education needs of our workforce cannot be overlooked because they affect

the current and emerging capabilities of our warfighters. Finally, as the plan is developed, the phased implementation of an integrated LVC architecture must be adaptable to rapidly assimilate new tactics, techniques, procedures, and technologies.

The integrated infrastructure for conducting LVC activities must be robust and responsive. The current planning and setup times are too lengthy to be responsive to rapid demands, especially in a wartime environment. A sudden Air Expeditionary Task Force deployment requires the ability to provide a mission rehearsal capability to the warfighter in *days* versus *months*. This realization means the warfighter must perform rapid planning and rehearsal using a persistent LVC environment that is relevant to the expected employment area. Further, rapid development and fielding of a critical warfighting system, such as a new weapon system, requires ready access to LVC capabilities that represent Command and Control, Intelligence, Surveillance and Reconnaissance, weapons, platforms, sensors, synthetic forces, and threats. For this LVC vision to come to fruition, an effective LVC-IA must describe a set of protocols, specifications, standards, and software that support the implementation and operation of a seamless and integrated environment.

Areas of emphasis

The LVC-IA 5-year plan is in reality a series of plans. These plans lay out measurable goals and milestones for the designated periods. Each annex represents a 5-year period, with objectives and milestones to achieve measurable progress in this multifaceted LVC-IA program. Annexes will be added over time to cover subsequent periods. The long range goal and the objective of these incremental steps is a persistent, adaptable, sustainable, and fully integrated LVC Enterprise Architecture that meets the needs of all M&S functional areas.

Workforce management

An integrated LVC Enterprise Architecture must address personnel resources as well as technical resources. Through workforce management, the Air Force will identify, educate, professionally develop, and track M&S expertise to support the LVC training environment. As the M&S training functional manager, the LVC-IA program will collaborate with major commands and other career field functional managers to determine the optimum makeup of the Air Force M&S future workforce and focus M&S capabilities and tools to support the warfighter. The Professional Development Program will provide continuing education, assist supervisors in creation of an individual development plan, and provide a community of practice with relevant information for all levels of the M&S workforce.

Policy alignment

Policies for integration and interoperability, from headquarters Air Force down to simulation centers, need to be reviewed to ensure clear and consistent guidance on implementation of M&S capabilities in support of all functional areas. Policies codifying responsibilities at major command level and below are inconsistent and, in some cases, nonexistent. To ensure effective integration and implementation of LVC-IA driven capabilities, the Air Force will need to align its policy. Working with SAF/XCDM, the Air Force's M&S Policy Division at the Pentagon, we are implementing and improving policy and procedures identified in current and future Air Force M&S policy directives and instructions. This will require top level oversight. An Air Force Requirements for Operational Capabilities Council (AFROCC)–approved program will facilitate this and help achieve a persistent LVC environment.

Programmatics

A fundamental precept of this LVC-IA plan is that a centralized management structure must be established. The acquisition category level and milestone start point will be determined based on estimated life cycle costs and HQ Air Force priorities. Proper documentation and coordination, in accordance with the Joint Capabilities Integration & Development System (JCIDS) process, will be required for program authority and funding approval. This includes securing AFROC and JROC approval to proceed. To comply with JCIDS requirements for establishing an LVC-IA Program Office, we are working on the 5-Year Plan to ensure that applicability and timelines are addressed for completing all relevant documentation.

Conclusion

Upon establishment of a centralized LVC-IA Program Office, with adequate funding for sustainment, the future of LVC activities will be on the road to persistent or semipersistent operation. Proliferation of unique solutions will diminish, reusable architectures will be established and managed, and built-in interoperability will emerge.

Operational art, according to Joint Publication 3-0, is:

> *"The application of creative imagination by commanders and staffs—supported by their skill, knowledge, and experience—to design strategies, campaigns, and major operations and organize and employ military forces… Operational art governs the deployment of those forces, their*

commitment to or withdrawal from battle, and the arrangement of battles and major operations to achieve operational and strategic objectives."

Testing and training must be tied to this concept first and foremost, for testing and training to any other purpose is meaningless to the warfighter (and ultimately the nation). Robust environments for tactical and operational level test and training that is pertinent to the tasks necessary to achieve the joint operating concepts of the Combatant Commanders requires a persistent LVC architecture:

1. Accurate and *readily available* operating environments relevant to anticipated current and future conflicts;
2. *Composable* friendly forces and opposition forces that represent enemy intent and capabilities;
3. *Feedback* capabilities that provide measurable data points to the warfighter for training tasks, and to the tester for developmental test and evaluation, operational test and evaluation, and live fire test and evaluation.

This architecture will achieve savings by reducing redundancies, inefficiencies, and standardizing the way we conduct testing and training. However, the true value of an integrated architecture to support these events is not simply a cost savings; rather, in most cases it is the *quality* measures that truly demonstrate the added benefit to accomplishing unit missions. Nonetheless, the value must be measured. Whether the mission is one of training, testing, experimentation, or other individual, team, or organizational tasks, appropriate data will be analyzed continually to ensure the optimum use of our limited Air Force resources. ❑

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